

## ANALYSIS OF METEOROLOGICAL DROUGHT FOR AJMER AND BIKANER DISTRICT OF RAJASTHAN

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### ABSTRACT

*Drought is an insidious hazard and is a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield and its impact vary from region to region. It conditions result from a lack of precipitation and can worsen after prolonged periods of no rainfall, especially in areas where the water supply is short. The main objective of the research to develop an approach and analyses of meteorological droughts based on precipitation data. If the mean weekly rainfall for 30 years of data from 1987 to 2016, then a week receiving rainfall less than 75 per cent of mean weekly rainfall is defined as drought week and greater than 125 per cent of mean weekly rainfall is defined as the surplus week. Week having rainfall between 75 per cent of mean weekly rainfall and 125 per cent of mean weekly rainfall is considered as the normal week. Rainfall Variability is the availability of water at a particular time and area. In this study, 30 years (1991-2016) of rainfall data of Ajmer and Bikaner district have been analyzed on yearly, monthly and weekly basis for predicting the water drought, normal and surplus event for crop planning in the region. Weekly drought, normal and surplus events give a more precise idea about crop planning than yearly and monthly events. The analysis has revealed that the percentage of drought weeks and months are more than normal and surplus weeks for both districts (Ajmer and Bikaner). So 1987 that there is a need of supplemental irrigation during the periods of water scarcity.*

**KEYWORDS:** Rainfall, Crop Planning, Irrigation & Ajmer and Bikaner District

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### INTRODUCTION

Different indices have been developed through time to quantify the magnitude of meteorological Drought has been defined and treated in various ways and various researchers from time to time and the impact of drought is governed by the magnitude, duration, frequency and spatial extent of the rainfall deficit (Degefu and Bewket, 2013) Magnitude refers to the amount of rainfall or water storage deficit at a particular place and specific time. It can be categorized into four basic types as meteorological, agricultural, hydrological and socio-economic droughts (Wilhite and Glantz, 1985; Tallaksen and Van Lanen, 2004; Mishra and Singh, 2010). In meteorological and climatological drought is defined in terms of the magnitude of a precipitation shortfall and the duration of this shortfall event. Agricultural drought is defined as soil moisture is insufficient and affects the crop may wilt due to soil moisture stress resulting into reduction of yield during crop growth. Hydrological drought is defined as the situation of deficit rainfall when the hydrological sources like streams, rivers, lakes, wells dry up and groundwater level depletes and affects industry and power generation. Socioeconomic drought is associated with the supply and

demand of some economic good with elements of meteorological, agricultural, and hydrological drought. These indices are based on rainfall, evapotranspiration, and temperature (Steinemann et al., 2005). Some of the widely used indices include the the Standard Precipitation Index (SPI) (McKee et al., 1993), the Deciles approach (Gibbs and Maher, 1967), Palmer Drought Severity Index (PDSI) (Palmer, 1965), the Percent of Normal, and Standard Precipitation Evapotranspiration Index (SPEI) (Vicente-Serrano et al., 2010). Drought classification based on category to give better results for the investigation of meteorological drought and analysis of rainfall data used for better crop planning (Kumar et al., 2009) and to know the chances of occurrence of drought during the critical stages of the crops and planning for protective irrigation and intercultural operations (Shinde et al., 2016). For the purpose of this study, meteorological drought was adopted where rainfall is commonly used for drought analysis. Yearly monthly and weekly rainfall plays an important role in estimating normal, surplus and drought events.

## METHODOLOGY

### Location of Study Area

The study was carried out for Ajmer and Bikaner districts of Rajasthan. Ajmer is situated in the semiarid humid zone and it is located between 26°27' N latitude and 74°37' E longitude and at an altitude of 475 m above mean sea level. The Ajmer district received 539.85 mm rainfall from 1987 to 2016. This region has steppe type of vegetation. Bikaner is situated in the arid zone at an altitude of 230 m above mean sea level. It is located between 28°01'N latitude and 73°18'E longitude. The Mean rainfall of the district from 1987 to 2016 is 638.94 mm. Daily rainfall data was collected from Water Resources Department, Government of Rajasthan. Year, month and Week wise events then classified as drought, normal and surplus depending upon the following criteria. If 'A' is the mean weekly rainfall for 30 years of data from 1991 to 2016, then a week receiving rainfall less than 75 per cent of 'A' value is defined as drought week and greater than 125 per cent of 'A' value is defined as the surplus week. Week having rainfall between 75 percent of 'A' value and 125 per cent of 'A' value is considered as the normal week. Year wise, month wise, and week wise rainfall was determined for Ajmer and Bikaner districts.

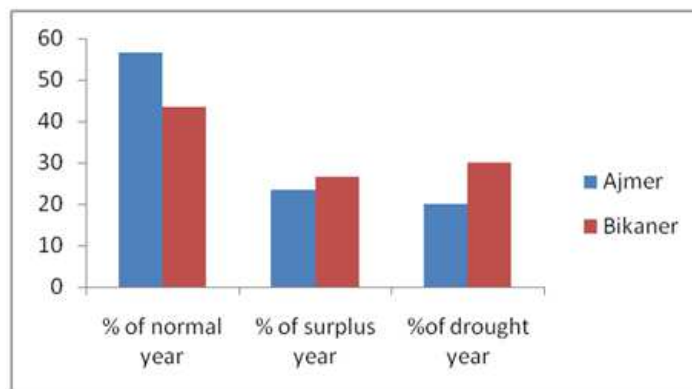
Table 1

S:No	Rainfall Range	Category
1	<75%	Surplus
2	>=75% to <=125%	Normal
3	>125%	Drought

## RESULTS AND DISCUSSIONS

### Yearly Drought Investigation

Yearly rainfall data of Ajmer and Bikaner districts were analyzed statistically and results are presented in Table 1. The numbers of normal, surplus and drought years in Ajmer were 17, 7 and 6 year with 56.6, 23.3 and 20 per cent years, respectively from 1987 to 2016. The numbers of normal, surplus and drought years in Bikaner were 13, 8 and 9 year with 43.3, 26.6 and 30 per cent years, respectively from 1987 to 2016. The percentage of coefficient of variation between drought, normal and surplus years in Ajmer and Bikaner districts was 60.83 and 26.45 percent respectively. The annual drought variation curve in both districts is presented in Figure 1. The frequency of drought was more in Ajmer as compared to Bikaner district.



**Figure 1: Yearly Drought Variation in Ajmer and Bikaner Districts**

**Table 1: Yearly Drought Investigations for Ajmer and Bikaner Districts**

Name of Stations	No: of Normal Year	No: of Surplus Year	No: of Drought Year	% of Normal Year	% of Surplus Year	% of Drought Year	Coefficient of Variance in %
Ajmer	17	7	6	56.67	23.33	20	60.83
Bikaner	13	8	9	43.33	26.67	30	26.45

**Table 2: Monthly Drought Investigations for Ajmer and Bikaner Districts**

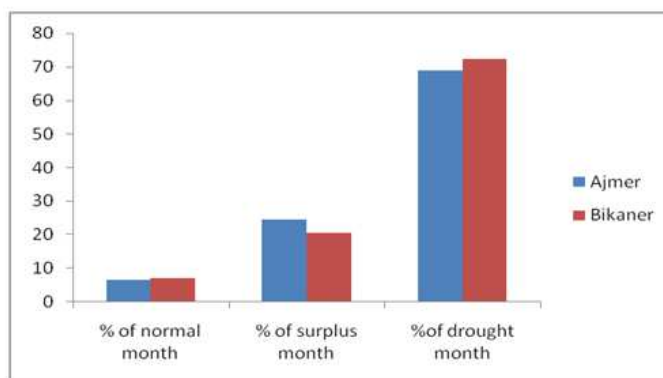
Name of Stations	No: of Normal Month	No: of Surplus Month	No: of Drought Month	% of Normal Month	% of Surplus Month	% of Drought Month	Coefficient of Variance in %
Ajmer	24	87	249	6.67	24.17	69.17	96.73
Bikaner	26	74	260	7.22	20.56	72.22	102.99

**Table 3: Weekly Drought Investigations for Ajmer and Bikaner Districts**

Name of Stations	No: of Normal Week	No: of Surplus Week	No: of Drought Week	% of Normal Week	% of Surplus Week	% of Drought Week	Coefficient of variance in %
Ajmer	66	273	1221	4.23	17.50	78.27	118.43
Bikaner	48	268	1244	3.08	17.18	79.74	122.41

### Monthly Drought Investigation

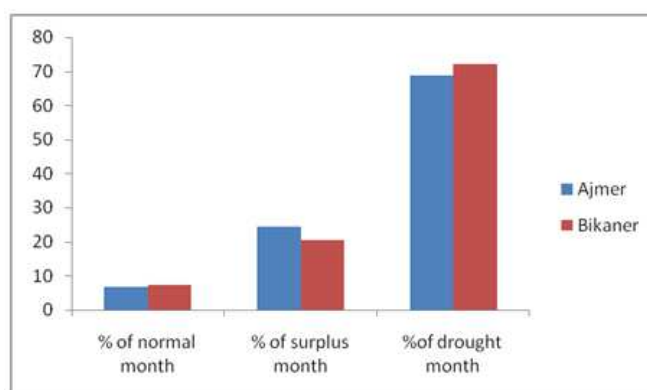
Monthly rainfall data of Ajmer and Bikaner districts were analyzed statistically and results are presented in Table 1. The numbers of normal, surplus and drought months in Ajmer were 24, 87 and 249 months with 6.6, 24.1 and 69.1 per cent months, respectively from 1987 to 2016. The numbers of normal, surplus and drought months in Bikaner were 26, 74 and 260 months with 7.2, 20.5 and 72.2 per cent months, respectively from 1987 to 2016. The percentage of coefficient of variation between drought, normal and surplus months in Ajmer and Bikaner districts was 96.73 and 103 percent respectively. The monthly drought variation curve in both districts is presented in Figure 2. The frequency of drought was almost nearly equally to both districts. Percentage of drought months in both the districts is more when compared to surplus and normal months



**Figure 2: Monthly Drought Variation in Ajmer and Bikaner Districts**

### Weekly Drought Investigation

Weekly rainfall data of Ajmer and Bikaner districts were analyzed statistically and results are presented in Table 1. The numbers of normal, surplus and drought weeks in Ajmer were 66, 273 and 1221 weeks with 4.2, 17.5 and 78.2 per cent weeks, respectively from 1987 to 2016. The numbers of normal, surplus and drought weeks in Bikaner were 48, 268 and 1244 weeks with 3.0, 17.1 and 79.74 per cent weeks, respectively from 1987 to 2016. The percentage of coefficient of variation between drought, normal and surplus weeks in Ajmer and Bikaner districts was 118.43 and 122.41 percentage respectively. The weekly drought variation curve in both districts is presented in Figure 3.



**Figure 3: Weekly Drought Variation in Ajmer and Bikaner Districts**

### CONCLUSIONS

Based on the study of rainfall data during 1987 to 2016 of Ajmer and Bikaner district have been analyzed on yearly, monthly and weekly basis for predicting the water drought, normal and surplus event for crop planning in the region. The analysis has revealed that the percentage of drought weeks and months are more than normal and surplus weeks for both districts (Ajmer and Bikaner) and reveals that there is a need of supplemental irrigation during the periods of water scarcity.

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